

## All about AS-Interface

An overview for new  
and experienced users



# as-interface

Basics  
Design  
Practice  
Utility



# SIEMENS

# The “eyes and ears” of production

When you automate a process, sensors and actuators are always required. Whether it be in a logistics center, where light barriers check the position of a package on a conveyor belt, in a beverage bottling plant where the liquid level is checked, or in a steel mill where beams have to be cut at a precise position. Sensors – the eyes and ears of process control – are everywhere.

For a long time, these transmitters and transducers were cabled in the same old way: Each individual sensor and actuator was directly wired to the higher-level control, resulting in complex and messy bundles of cables with the associated electrical cabinets. In the mid nineties, with the introduction of the AS-Interface®, bus technology – already a standard at the field and control level – established itself in the world of binary sensors and actuators.

A general standard was agreed on which was rugged and flexible enough to fulfill all of the requirements of an industrial data bus. However, it simultaneously addressed the special requirements of the “lowest” control level. Now, process-related devices (sensors, actuators, and operator units) can be interlinked with one another and connected to industrial communication systems – and that extremely simply and effectively.

In all of the automation technology, the AS-Interface is the simplest and most favorably priced solution. As of now, there is no serious competition. With the backing of a strong international organization as well as the leading manufacturers, AS-Interface will dominate the market, also in the future.

This brochure addresses those interested in the AS-Interface as well as users and provides an insight into the technology behind the AS-Interface and how it is used in the field.



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# 1.

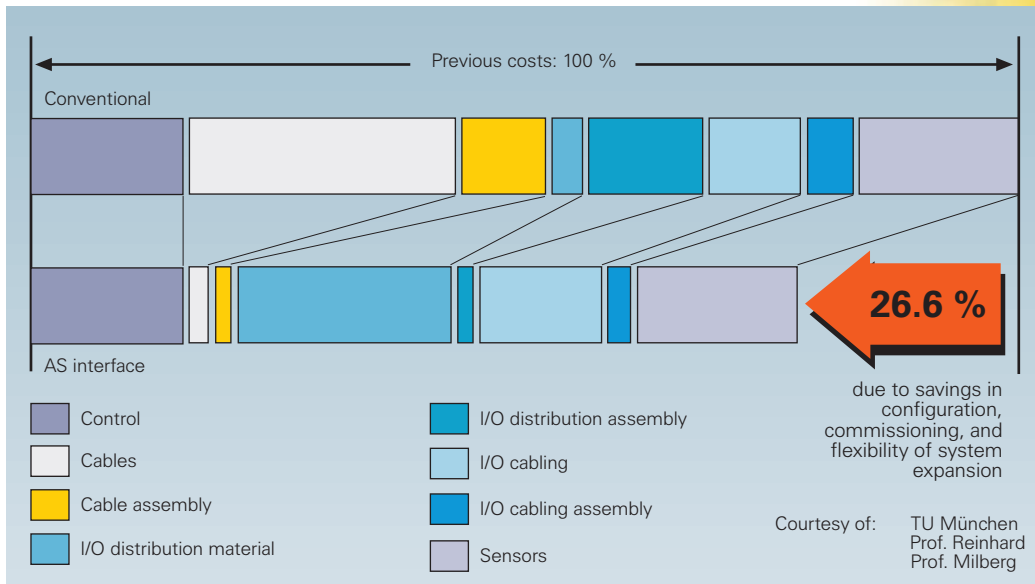
AS-Interface with which process and local machine, digital and analogue signals can be transmitted in binary form has been around since 1994. AS-Interface is also the universal interface between the higher control level and simple binary actuators and sensors.



*In the past each individual sensor had to be wired to the controller (parallel wiring). Today, the sensors and actuators are simply connected to each other and to the control via one cable – the AS-Interface cable.*

## **Field bus technology – why “go by bus”?**

What made us develop AS-Interface? Not so long ago, the pressure to cut costs in automation forced structural changes. This was triggered by the immense cabling costs that had to be invested to connect the field level to automation equipment (usually programmable controllers). Every actuator and every sensor had to be connected to the control and to a power supply, that involved high material costs (wire costs money too) and the astronomical cabling costs already mentioned, whilst at the same time giving rise to a considerable source for errors.



*A comparison of the costs between conventional installation technology and AS-Interface using the example of a milling machine.*

Even as late as 1997, 36% of all machine and plant failures were caused by the installation.

The magic word was (and still is) decentralisation – first in automation technology, later in drive and switching technology, too.

What was meant by that? Well, simply that the conventional, cost-intensive parallel wiring (cable looms) was replaced by a serial field bus, or a two-wire cable with which all automation nodes can be interconnected.

The cost advantages are considerable: For example, according to a study by the Technical University of Munich, you can save more than 25% of the installation costs if AS-Interface is used on a milling machine. Even if the costs for

the AS-Interface modules are initially higher, savings up to 15% to 30% in total are quite common. The savings are to be seen in reduced configuration, and commissioning time, and in achieving greater flexibility when the system has to be expanded.

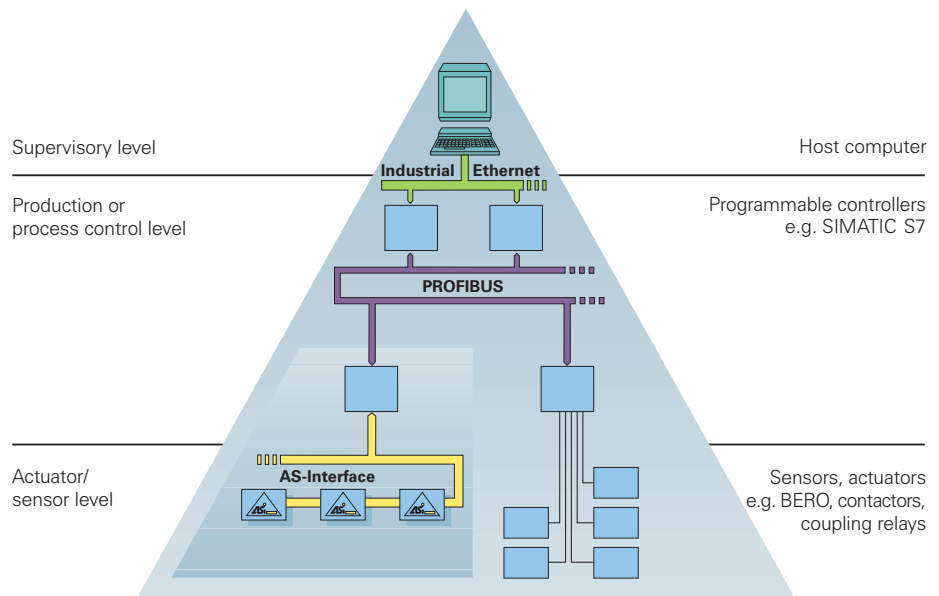
### Industrial communication

The structure of a complex automation system is pretty opaque even for experts: Numerous control devices are networked on different data networks and with different protocols. It has become customary to divide control levels according to hierarchies. They differ in their time response, degree of protection, type and use of data to be transmitted and many other aspects.

To help you understand the tasks of AS-Interface and its position in the control hierarchy in industrial communication, here is a short explanation of the basic properties of the various levels.

### Supervisory level

At the highest level, the supervisory level, the computers on the management level in a factory, or sometimes even in more than one factory, are inter-



*The various levels  
in industrial communication*

networked, or a host computer controls production as a whole using the computers as slaves. The data volume is in the megabyte range and transmission of the data does not need to be in real time. The transmission medium might be Ethernet.

#### **Field or process control level**

At the field and process level, PROFIBUS® (process field bus) has become standard. With a transmission rate of up to 12 Mbits/s in its DP version, it is ideal for the high demands of automation technology. PROFIBUS is now available as PROFIBUS-PA for process control, and the extensions added in 1999 for synchronism and peer-to-peer traffic will make it suitable for use in typical motion control applications in the future.

#### **Actuator/sensor level**

The actuator sensor level is the lowest level in the field area. Here, binary actuators and sensors in the field and process area are networked. Many of the devices connected, supply or require binary signals (e.g. BERO®; contactors, motor starter, solenoid valves, pneumatics, valve islands etc.). The necessary data volume is small, but the speed of data transmission is very high. A typical application for AS-Interface. AS-Interface has had an excellent track record in more than two million nodes since its introduction and has proven the most low-cost, robust, and best suited solution for the task, almost without competition.

## AS-Interface – The perfect solution

Before the task of developing a bus system, for the lowest field level which was both open and manufacturer independent (just like Ethernet or PROFIBUS) could be undertaken, a simple problem had to be solved: Components supplied by a wide range of different manufacturers which all had to be connected to the same bus system were not necessarily able to communicate smoothly with one another and with the system.



### AS International Association

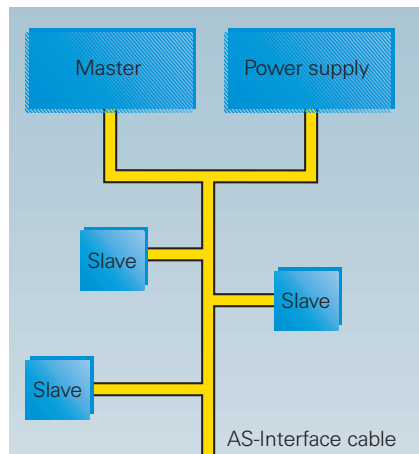
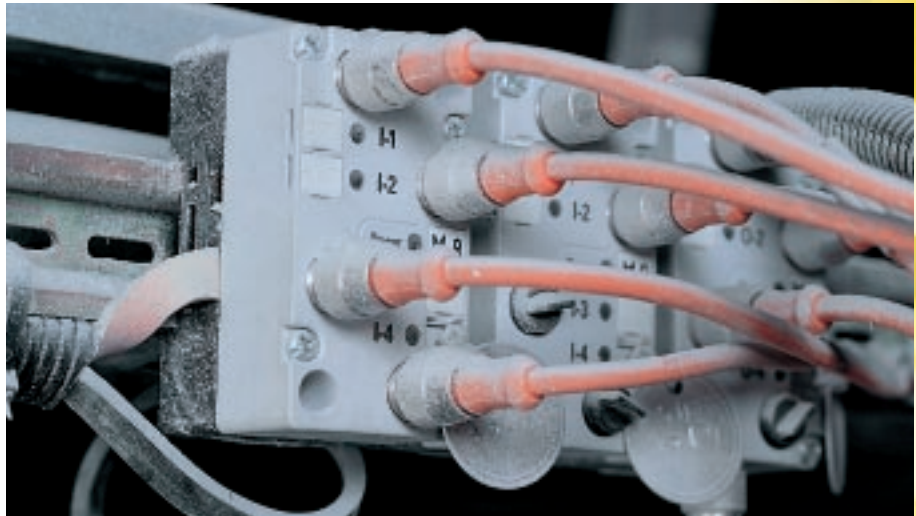
In 1990, eleven renowned companies active in the sensor and actuator field formed a consortium to make their components compatible.

That AS-Interface project gave birth to the AS International Association whose main tasks lay in, international standardisation, continued development of the system and certification of products. The user can recognise tested and certified products by the AS-Interface "shadow logo" and a test number.

### Requirements of AS-Interface

At the lowest control level, sensors, contactors, motor circuit switches, indicator lamps, pushbuttons etc. which transfer volumes of information in the bit range had to learn to communicate. The bus systems already in existence were either over dimensioned or simply could not be used for such a task. They used cables that were either too expensive or unsuitable for a direct link to the process (e.g. fibre-optic cable, shielded and non-flexible cable), and the volumes of data transmitted were simply too high. Either the data protocols were non-deterministic or the control electronics used were much too expensive if each binary sensor was to be a bus node and in an automation network there might be any number of them. Over and above that, assembly and installation needed to be as simple as possible, without the need for any special training. The costs for each connection should be low and in keeping with the volume of data to be transferred. In short: AS-Interface had to be able to network binary sensors and actuators and link them to the higher control levels, very simply, inexpensively, and meeting industrial requirements.

*With IP67, AS-Interface is well equipped to deal with dust, humidity, and extreme temperatures.*



*Minimum configuration of an AS-Interface network*

The technical result is remarkable. AS-Interface fulfils all the requirements just about perfectly, in field use (IP65/IP67), in the control cabinet (IP20), and in temperature ranges from -25 °C to +85 °C.

### **Single master system**

AS-Interface was conceived as a single master system with cyclic polling. This means that there is only one control module (master) in the AS-Interface network which polls the data of the other nodes (slaves) at precisely defined intervals.

### Small volumes of data

AS-Interface has been optimised for volumes of data that correspond precisely to the requirements of the lowest field level. The structure and length of the data frame is fixed. Up to four useable Input bits and four useable Output bits are exchanged between a slave and the master in any one cycle.

### Real-time requirements

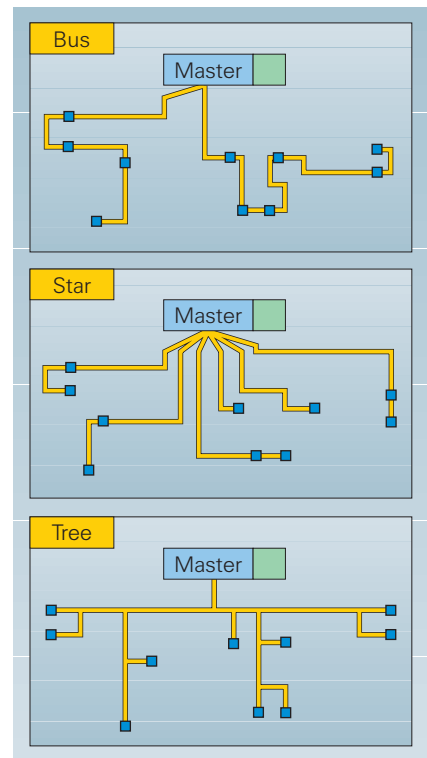
The maximum cycle time, i.e. the time that a master takes until a node is polled again is a maximum of 5 ms for a fully utilised system with up to 31 standard slaves. In a fully utilised AS-Interface system according to the extended specification 2.1, the maximum cycle time is 10 ms for 62 slaves. In most control systems this time meets the “tough real-time requirements”. Polling procedures are deterministic, i.e. the master “knows” that it can access the current data of each node connected to the AS-Interface network within a certain time.

### Data transmission

Simple two-wire cables without shielding or PE conductor are used to carry both data and the auxiliary power for the sensors simultaneously. The intelligent data protocol is structured in such a way that the entire system is extremely interference resistant. Shielding is therefore not necessary.

The yellow profiled AS-Interface cable has become a characteristic feature of AS-Interface. Its innovative contacting system (insulation displacement technology) makes it simple and efficient to assemble. An AS-Interface network can, of course, also be configured with standard circular conductors. For economic reasons, however, the ribbon cable is the preferred option.

*Bus, star, or tree  
AS-Interface network  
configurations are possible*



### Network topology

The AS-Interface network can be configured like any conventional electrical installation. Due to the robust functioning principle behind the structure, any network topology can be used. Tree, bus, or star topologies are possible.

### More AS-Interface with new Specification

In an AS-Interface system configured and designed according to Specification 2.1, up to 62 A/B slaves can be con-

nected. The slaves have the capability of having 4 input and 3 output addresses maximum (i.e. up to 248 inputs and 186 outputs within an AS-Interface system). In a standard AS-Interface system up to 31 slaves can be connected, each slave having up to 4 inputs and up to 4 outputs (i.e. a total of 124 inputs and 124 outputs).

Intelligent sensors with integrated AS-Interface chips each have their own slave address and are interpreted as "normal" slaves by the master.

## AS-Interface Version 2.1

With Version 2.1 you can operate up to 62 slaves instead of the previous 31 on one AS-Interface network. This works as follows: The 31 addresses that are possible and available in a standard AS-Interface network are split into two independent subaddresses - e.g. in 1A and 1B. If you use this option for all 31 slaves, a total of 62 stations are possible. To take advantage of this new specification a new range of compatible AS-Interface masters and slaves are available. The new V2.1 slaves – called A/B slaves – have up to four input and three output addresses available. On the front of the new modules, increased "easy-to-use" diagnostics are possible by means of LED's. Other added benefits of the new specification are that improved transmission times are now capable for analogue input or output slaves. An AS-Interface network can now consist of old and new slaves (i.e. Standard and version 2.1 AS-Interface) allowing upward and downward integration of existing AS-Interface networks. This

means that existing applications can be expanded with new V2.1 slaves and V2.1 masters can communicate with the existing slaves on a network. It must be remembered that masters that do not support Specification 2.1, can only support standard slaves and not the new A and B slave addresses. The actual principle of operation is as follows: The standard slaves are polled in each cycle (max. cycle time: 5 ms). Even if only one A or B slave is installed at an address, this slave is scanned in each cycle with a maximum cycle time of 5 ms. If only one A/B slave pair is installed at an address, the A slave is scanned in one cycle, and the B slave is scanned in the next (max. cycle time: 10 ms). A/B slaves can be addressed like standard slaves via all new commercially available AS-Interface addressing units that conform with the new Specification 2.1. It should be noted that any AS-Interface addressing units that do not conform with the new Specification 2.1 can only re-address A/B slaves as an A slave.

# 3.

## AS-Interface – Its main components

### Master

The AS-Interface master provides the link to the higher-level controller. It organises data transmission along the AS-Interface cable automatically, making the signals of the sensors and actuators available to higher-level bus systems, e.g. PROFIBUS, at an interface. See also Links.



*The complete controllers of the SIMATIC S7 range can also be used as AS-Interface masters*

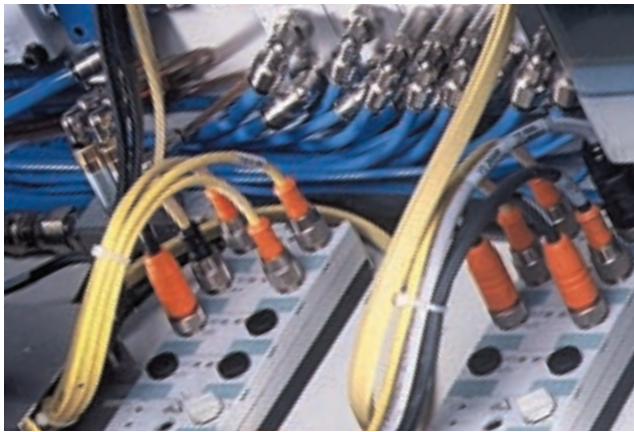


*Example of an AS-Interface master: CPU 343-2 for SIMATIC S7-300*

In addition to polling signals, the master also transfers parameter settings to the individual nodes, continuously monitors the network and performs diagnostics. Unlike more complex bus systems, AS-Interface is a self-configuring system. The user does not have to make any settings, e.g. access authorisation, data rates, frame type etc.

The master automatically performs all the functions required for the correct functioning of AS-Interface. It also performs self-diagnostics functions. It recognises faults and automatically assigns the correct address to a slave removed for maintenance.

*Up to four binary sensors and actuators can be connected to a standard AS-Interface module.*



*Decentralised start-up of a DC motor: No problem with the DC starter module and AS-Interface*

## **Slave**

The most important component of the whole AS-Interface system is so small that would fit comfortably on a fingernail. But without it, AS-Interface would never have become as important as it is today. We're talking about the AS-Interface slave chip. Slaves are actually distributed I/O modules of the programmable controller (PLC).

AS-Interface modules recognise the data bits transmitted by the master and returns their own data. Up to 4 binary sensors and actuators can be connected to any one standard AS-Interface module. An intelligent slave is one where the AS-Interface chip is integrated into the sensor or actuator. Costs for electronics are minimal.

AS-Interface slaves are available as digital, analogue, and pneumatic modules, and as intelligent nodes, e.g. motor starters, LED columns or membrane keyboards. Single-acting and double-acting pneumatic cylinders can be controlled with pneumatic modules. That means not only savings in cabling, but in tubing, too!

## **Links**

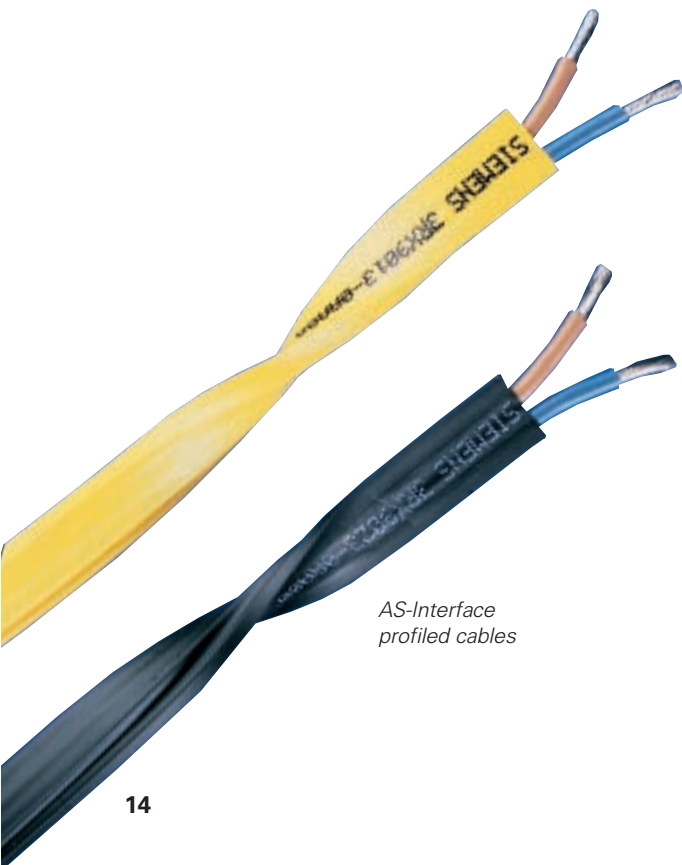
In more complex automation structures, AS-Interface can also be connected to a higher level field bus, e.g. PROFIBUS. For this, it requires a gateway (e.g. DP/AS-i link) which is used as an AS-Interface master in the AS-Interface network but which functions as a slave in the higher level field bus (e.g. PROFIBUS). In such a configuration, AS-Interface is the supplier of binary signals to any higher level field bus system.

## Cables

The yellow profiled cable has become synonymous with AS-Interface. It has a geometrically defined cross-section and simultaneously transmits data and auxiliary power to the sensors. Additional auxiliary power is required for the actuators (aux. voltage, e.g. 24 V DC). Different coloured profiled cables have been specified utilising the same installation technology. A black profiled cable is therefore used for 24 V DC auxiliary voltages.

The core insulation usually consists of a rubber mixture (EPDM). For applications where demands are greater, e.g. resistance to chemicals, profiled TPE (thermoplastic elastomer) or PUR (polyurethane) cables are available. However, round two-wire cables without PE conductor can also be used as the transmission cable.

The transmission technology obviates the need for cable shielding.



*AS-Interface  
profiled cables*

### Power supply units

AS-Interface power supply units are a necessity of an AS-Interface network. They produce a controlled DC voltage of 30 V DC with a high degree of stability and low residual ripple and work on the principle of a primary switched-mode regulator.

Data and power are always transmitted simultaneously via the AS-Interface

twisted-pair cable. For that reason, the AS-Interface power supply units ensure not only the power supply to the AS-Interface power supply unit but also data decoupling.

That is why no standard power supply units must ever be used to power an AS-Interface network.

AS-Interface power supply units supply the electronics of the network (AS-Interface master, AS-Interface modules) and all connected sensors. Depending on the power requirement of the AS-Interface network, a range of power supply units graded from 2.4 to 7 A are available.

The power for the actuators (outputs) is usually not taken from the AS-Interface cable but from a separate power supply that is connected to the slaves by means of a separate cable (e.g. black AS-Interface profiled cable). In this way, it is also possible to implement EMERG. STOP circuits for local and remote isolation. For cases in which an auxiliary power supply is required in addition to the AS-Interface power, the very compact 1 x 30 V DC and 1 x 24 V DC combined power supply unit can be used. For the power supply to the output circuits an external additional 20 to 30 V DC power source (AUX POWER) is required. The additional power source must conform to VDE 0106 (PELV), protection class 111.



*AS-Interface  
power supply unit*

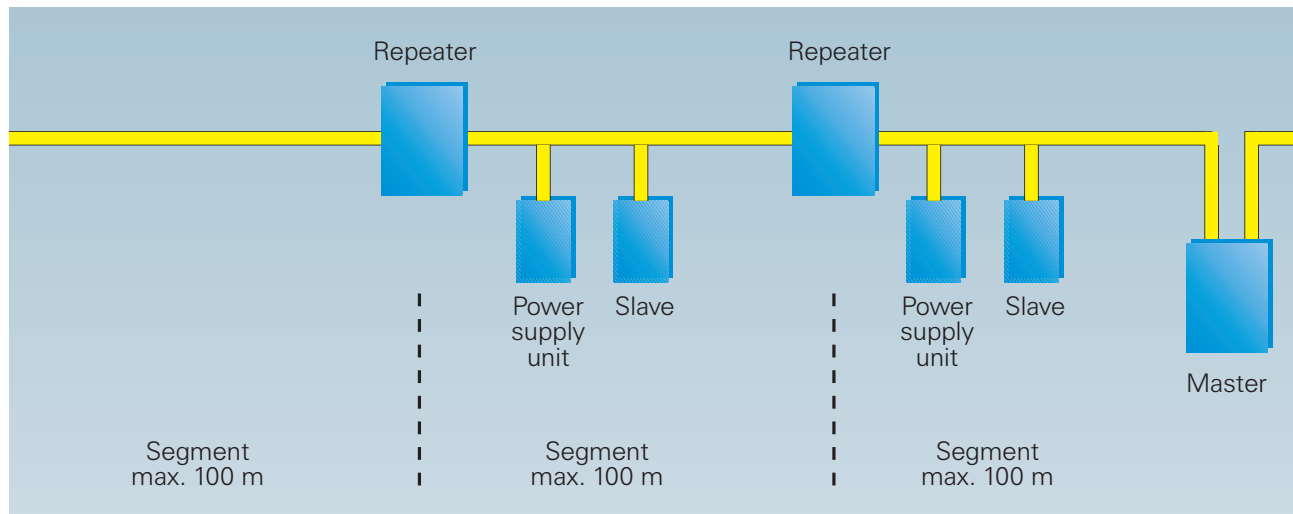
### Additional components for expansion with ...

The AS-Interface functions without any problem with standard components up to a length of 500 m – without repeaters or extenders up to 100 m.

### ... repeaters

When using repeaters, up to two repeaters can be connected in series, on which all components can be distributed to the segments in any way. But there is a widespread misunder-

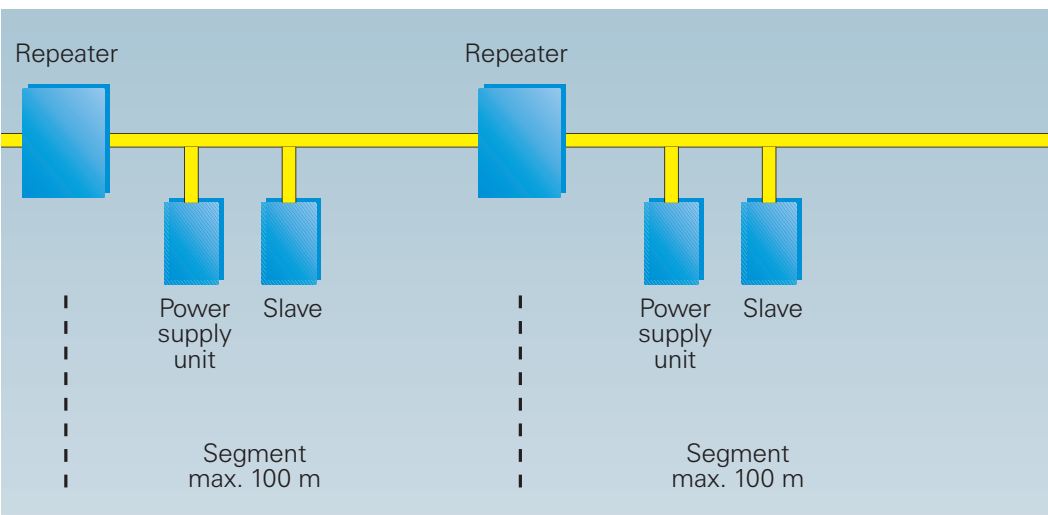
ing that an AS-Interface network therefore has a maximum extent of 300 meters! Much larger extents are possible because parallel arrangement of several lines in a star configuration is possible. In a mail sorting system, an AS-Interface network has a total extent of 1600 meters. The repeater works as an amplifier. The slaves can be connected to all AS-Interface segments. Each segment requires a separate power supply unit. In addition, the repeater isolates the two segments, which improves selectivity in the event of a short-circuit.



### ... extenders

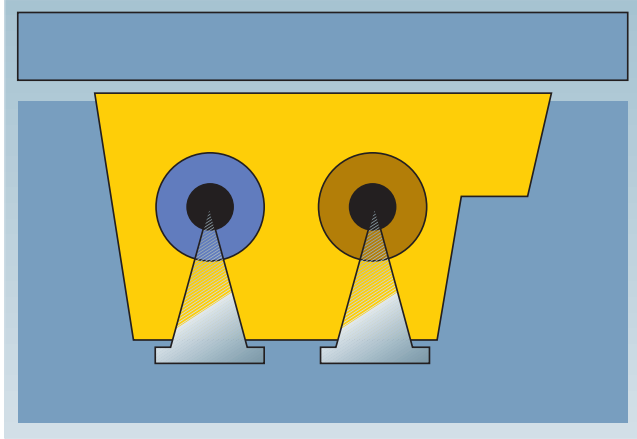
The AS-Interface cable can also be lengthened by 100 m using extenders, in which case no slaves must be used in the first segment. Extenders are only recommended for covering large distances, say, between the control cabinet and the plant.

*A total cable length of up to 500 m with standard components: two lines with a star network topology run in opposite directions from the centrally located master each to a repeater. The maximum permissible cable length between the master and all repeaters is 100 m, so that if 2 extenders are used a distance of 50 m can be covered. After each repeater, a new segment begins, each with a cable length of 100 m. With further repeaters the network can again be expanded by 100 m on both sides. This results in a total length of 500 m for one AS-Interface network.*



# 4.

## AS-Interface – Simple connection



*It couldn't be  
simpler: Insulation  
piercing  
connection*

### Modular technology

Modular technology is a typical element of AS-Interface technology. Slaves that are made up of two parts are used: A mounting plate forms the lower part, and the module itself, the upper part. The cable is then sandwiched between the two. The modules contain the AS-Interface electronics and the connections for the sensors and actuators. A wide range of different modules are available.

### Insulation piercing technology

Profiled cables can be connected to the slave interfaces at any location easily and safely. This has been made possible by insulation piercing.

How it's done: Contact needles pierce through the cable insulation and make secure contact with the copper conductor. When the needles are pulled out again to remove a slave, the cable's self-healing capability means that the holes close automatically, providing full insulation again (in the case of EPDM cables).

The geometry of the cable means that polarity reversal is practically impossible and there is no shielding to worry about.



*The cables are simply placed on the lower plate of the slave. In this picture, the lower plate of a K45 module*

# AS-Interface in practice

## 5.

AS-Interface has not only become a standard industrial interface for connecting simple binary devices. The claim of “easy entry without special bus know-how” is not exaggerated. On the contrary: The superiority of AS-Interface lies in its simplicity.

### Beginner's checklist

Here is a checklist of 10 points for the beginner, to make entry into the world of AS-Interface even easier:

#### 1. How many inputs and outputs are needed?

The number of inputs and outputs tells you how many AS-Interface networks you need.

#### 2. How much power do the I/Os consume?

The total power requirement of the required modules determines which AS interface power supply unit you need. As it is not possible to connect power supply units in parallel, a power supply unit sized to the power requirement must be used.

#### 3. Are special cables required?

Any combination of profiled and round cables is possible. External conditions determine whether rubber, TPE or PUR cables have to be used. Repeaters or extenders (See Page 16) have to be used for cable lengths above 100m.

#### 4. Is address assignment correct?

For clarity's sake, a plan should be drawn up, clearly showing which addresses are assigned to which slaves. Double assignments are not necessarily recognised as errors by the master.

#### 5. Which modules belong to which addresses?

Modules and slaves that are addressed should be labelled clearly.

**6. When are the modules mounted?**

Only when points 4 and 5 have been dealt with. Cables can be routed in any way.

**7. How is it all configured?**

The configuration is simply read in by entering the AS-Interface profile for each slave in the master. This usually happens automatically but can be done manually in the controller software.

**8. Are the slaves detected?**

First you must check whether the master has recognised all its slaves. Only then can you switch to protected operation and switch the controller to RUN.

**9. How is testing done?**

Input/output tests are performed by the familiar PLC method, i.e. the sensors are activated locally and then checked in the PLC.

**10. How do you get the whole thing up and running?**

You can either create your own controller software in the usual way or use existing software. In the latter case, you might have to adapt the symbolic assignment of addresses.

### Configuring

As far as AS-Interface is concerned, configuring means nothing more than drawing up a list of the configured slaves and then storing it in the master. Configuring is usually performed at the master, which means that the master automatically reads in the network configuration. (The user can also make settings for special applications at the PLC).

The slave address and the slave type (ID code), the I/O configuration (I/O code), and the parameters (in the case of intelligent sensors), if they exist, are defined during configuration. The master uses this list to check that the configuration programmed matches the actual configuration. Before this is possible, the slaves must be addressed.



### Addressing of the individual nodes

The addresses of all the slave nodes must be programmed before AS-Interface is put into operation. You can do this offline with an addressing device, online at the master of the AS-Interface system, or after installation using integrated addressing sockets.

The addresses themselves are the values 1 to 31 or 1 A/B to 31 A/B with the extended specification. A new slave that has not yet been addressed has address 0. A new slave that has not yet been addressed is assigned the address 0. It is then recognised by the master as a new slave that has not yet been addressed, a state in which it is not yet involved in normal communication procedures.

The slaves can be assigned any address – it does not matter whether a slave assigned address 21 is followed by slave 28, or whether the first slave is assigned address 1.

*Addressing unit  
for AS-Interface*

### **Parameterisation**

Usually, slaves are not parameterised. Only intelligent slaves with required options are parameterised. The data sheet of the slave in question defines whether it has to be parameterised and what function the parameters have. Whereas the address of a slave never changes in normal operation, the parameters are very likely to change. We therefore make the distinction between variable and fixed parameters.

Fixed parameters are defined only once during configuration. The parameters themselves are bits, of which four are made available to each module, each of which can be set to 0 or 1. They are transferred to the slaves when the system is started up.

### **Operation**

As soon as the AS-Interface system is set up, i.e. all the components have been installed, the slaves are addressed and, where necessary, parameterised, and configuration is complete, it's time to start: The system switches to normal operation, and the master runs in protected mode.

Only the slaves that have been configured are activated. Slaves that are not configured – e.g. those that have been added subsequently – merely return an error signal. All you have to do to include such a slave in the communications network is to switch to configuring mode. The function "Configure slaves" sees to that. It's as easy as that.

The system is constantly monitored, both when it is started up for the first time and during normal operation. The necessary data, such as voltage, mode, incorrect configuration etc., is sent to the higher-level controller by the AS-Interface master, e.g. in the form of a diagnosis.

### Ten valuable tips on assembly

The following 10 tips should be followed to make sure nothing goes wrong during assembly:

#### Tip 1 – Power supply unit

On no account must AS-Interface be grounded! Never use a normal power supply unit only AS-Interface power supply units (PELV) with integrated data de-coupling and connect "ground (GND)" with system ground.

#### Tip 2 – Network extension

Without repeaters or extenders the AS-Interface cable must be no longer than 100 m – including all feeders to the assembly terminals! If you want to expand the network please note the following:

Expansion with extenders:

- The maximum cable length between the extender and the master must be no longer than 100 m
- Do not connect any slaves or AS-Interface network power supply unit between the master and the extender.
- Lines "+" and "-" must not be swapped round.

Extension with repeaters:

- Up to two repeaters must be connected in series - that makes the cable length in a feeder no more than 300 m (i.e. 3 segments with up to 100 m).
- An AS-Interface power supply unit must be connected at every repeater.
- An extender must not be connected beyond a repeater

#### Tip 3 – Slaves

Each slave address must only be used once. Only use addresses 1 to 31 or 1A to 31B in A/B technology (Specification 2.1). Please note: All modules that contain the SAP 4.1 chip can be readdressed any number of times.

#### Tip 4 – Additional auxiliary power

If slaves are to be given an additional auxiliary power supply

- A PELV power supply unit and, if necessary, the black profiled auxiliary power cable should be used.

**Tip 5 – Routing of the cable**

When laying the AS-Interface cable please note the following:

- Always use the yellow profiled AS-Interface cable where possible, brown for “+” and blue for “-”.
- Even whilst communication along the AS-Interface cable offers a high degree of EMC immunity, it should still be routed away from power cables, even in the control cabinet!
- Every AS-Interface line requires its own cable. AS-Interface cables must not be laid together with others in a bus cable.
- If individual cores are used (e.g. in the control cabinet), always lay parallel core pairs. In standard stranded wires, lay individual cores together or twist them.

**Tip 6 – Ensuring EMC**

Connect all inductance's, e.g. contactor and relay coils, valves, brakes, with suppresser diodes, varistors or RC elements. If frequency converters are used, always use network filters, output filters, and shielded motor cables.

**Tip 7 – Sensor and actuator power**

Sensors and actuators must be supplied directly from the associated input or out-put of the slave. The cables should be kept as short as possible and away from energy cables, i.e. the slave modules should be as close as possible to the sensors and actuators.

**Tip 8 – Installation of frequency converters**

- Always follow the assembly guidelines in the operating instructions.
- Connect the cable shield, e.g. between filter and frequency converter and between the frequency converter and the motor, directly at both ends with a large contact surface, and with a sufficient cross section (at least 4mm<sup>2</sup>).
- Connect all metal parts to system ground.

**Tip 9 – System expansion 2.1**

With masters to Specification 2.1 it is possible to operate A/B slaves and analog slaves according to Definition 7.3/7.4 (only as standard slaves).

**Tip 10 – Status/diagnostics**

For speedy diagnostics, the status and diagnostics bits should be analysed in the PLC.



### **What to do if something goes wrong**

Errors can occur even in the best systems. In AS-Interface too, there are error patterns that are usually easy to detect and just as easy to eliminate. The only error that AS-Interface cannot recognise is the failure of a binary sensor or actuator integrated in a module.

A defective slave can simply be replaced by a new slave. An AS-Interface cable break will of course result in the failure of slaves. By locating their position it is possible to find the cable break because the slaves located beyond the interruption point from the point of view of the master can then no longer be addressed.

A short circuit can have a disastrous effect on the system. The master therefore recognises a short circuit by the APF bit (AS-Interface Power Fail) and immediately takes action. All slaves immediately go into the status "not active". For the actuators that means that power stops flowing.

# 6.

## AS-Interface applications

Three applications have been chosen to show you how flexible AS-Interface is: Whether empty bottles of different types are distributed to the correct stations, overhead conveyor motors are

controlled in a car engine plant, or a high-speed laser-cutting machine is completely networked by using AS-Interface: Everywhere, AS-Interface shows just how flexible and efficient it is.

## Well sorted

*Empty bottle sorting at Bier Schneider, Dortmund*



*Germany's largest bottle sorting plant which covers a surface of 60 x 30m on three floors. A total of 8 AS-Interface lines all with a maximum cable length of 100 m provide full I/O cabling.*



*The company Dr. Wiewelhove in Telgte, Westphalia, has designed and built what is now the largest empty bottle sorting plant in Germany for Bier Schneider in Dortmund. The plant which covers a surface of 60 x 30m over three floors identifies and distributes up to 6,000 crates of every possible type every hour to a maximum of 14 stations.*

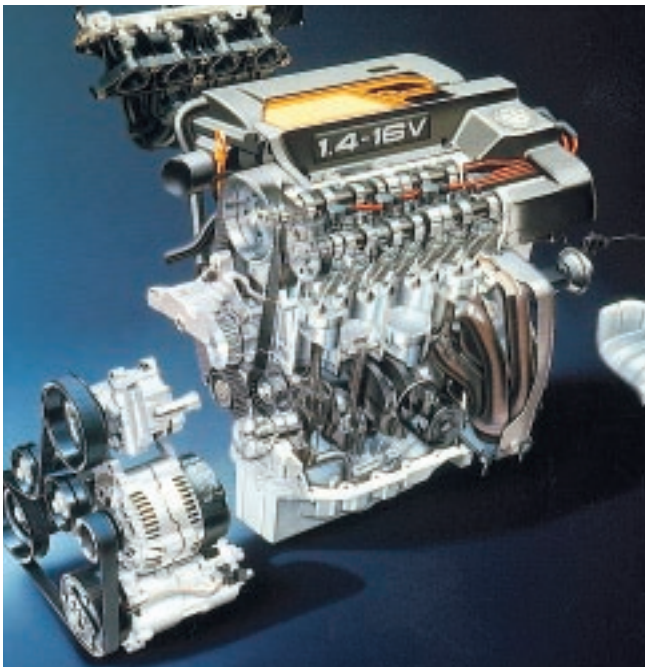
*AS-Interface is used to link the signal I/O of the sorting equipment to four SIMATIC S7-300s. The CP342-2 communication processor is the master and provides the link between the CPU of the controller and the AS-Interface. More than 100 digital modules each with four digital input signals connect the sensors distributed around the plant with the controllers. For the most part, these are Photo Electric Cells that ensure that*

*there are no jams. Two masters are used for each controller, which means that a total of eight AS-Interface lines with a maximum cable length of 100 m is sufficient for the entire I/O cabling. 20 pneumatic AS-Interface compact modules also operate in the plant. By reducing the entire installation to a few cables, such as AS-Interface, compressed air and emergency stop circuits, considerable areas of the plant could be standardised. One important aspect for H. Pelz, head of electrical design at Dr. Wiewelhove, were the huge savings on assembly and installation that AS-Interface made possible: "AS-Interface made it possible for us to assemble a plant at low cost on schedule, the reduced configuring phase being an important factor."*



# Round she goes

*Material handling with AS-Interface  
at the VW engine plant in Saxony Germany*



Putting the load feeders, e.g. motor starters, into the field means transferring the advantages of field bus communication to the power side. Switching and protection devices are mounted in close vicinity to the motor, so that the motor cable itself is very short. The distributed motor starters draw the energy they require from a single "power bus". This is the distributed motor starter concept that Volkswagen AG implemented in their car engine factory in Chemnitz, Saxony. A circular rotating overhead conveyor system which transports approximately 2,200 manufactured engines daily forms the backbone of the entire engine factory. It provides the connection between all the production areas, from the assembly line, through the engine testing bays, to the dispatch areas.

The distributed configuration of the I/O functions, such as the connection of the input and output signals, or the drives and their controls is made possible



*2,200 engines are checked, conveyed, and stopped daily. The stoppers are controlled by AS-Interface compact starters.*

*by AS-Interface. Only a few central control elements, e.g. for in-feed and safety technology, now remain in the control box.*

*Switches controlled by barcode readers are responsible for the controlled passage of the engines through the individual production sections of the circular conveying system.*

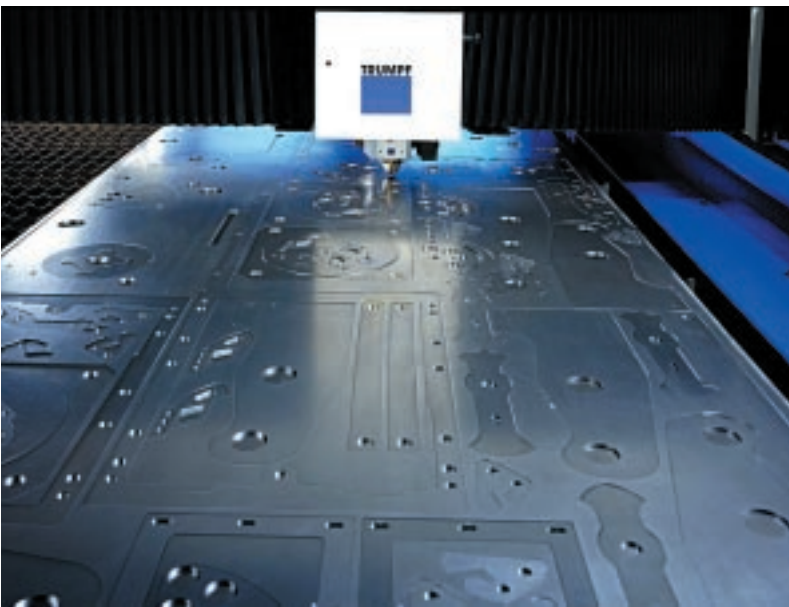
*Stoppers which can uncouple individual engines from the conveyor belt are used to ensure that a defined distance is kept*

*between the individual engines as they move along.*

*AS-Interface compact starters control these stoppers. Up to seven stopper motors can be wired up to the energy bus of a starter, making planning, assembly, and installation of the plant considerably easier. Standard I/O modules, compact starters and the SIGNUM<sup>®</sup> operating equipment of AS-Interface also meant that the hardware was configured in a very short time.*

# At the speed of light

*AS-Interface in operation  
with laser-cutting machines*



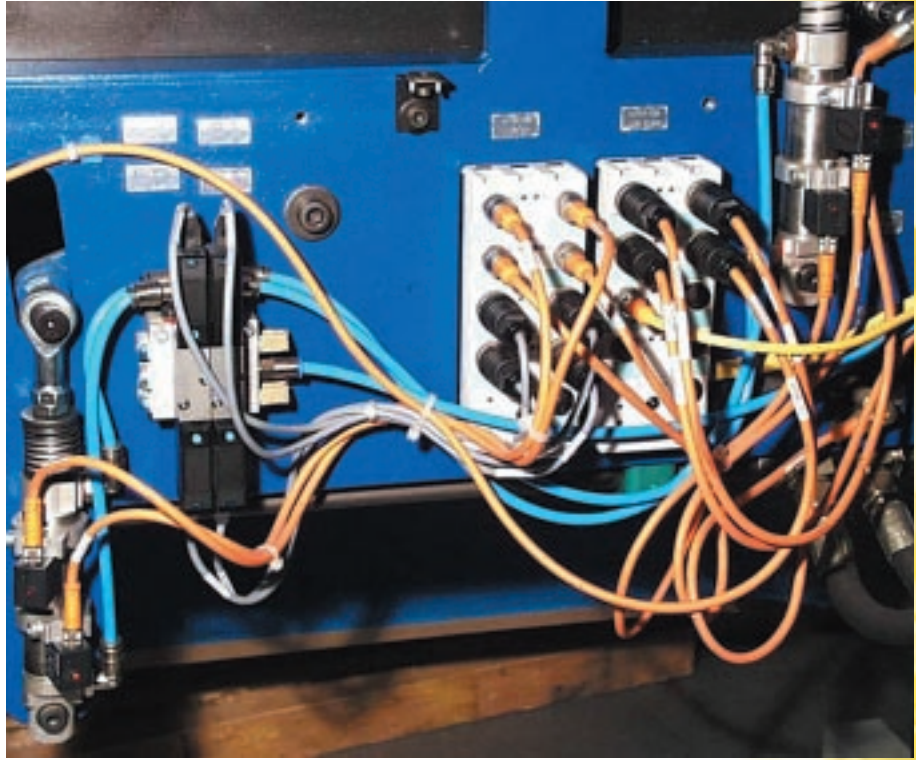
*The HSL2502 high-speed laser-cutting machine is the new showcase machine of Trumpf based in Neukirch, Saxony, Germany. The machine was networked completely using AS-Interface at the field level, including the auxiliary devices such as the hydraulic unit, extraction, closed-circuit cooling unit, and the in-feed system.*

*One of the important advantages of the new automation concept for Trumpf is that customer specific solutions can now simply be incorporated into existing electrical engineering projects. Thanks to standardized I/O interfaces, it is now possible to install and commission modules during the pre-production stage.*

*The distributed installation using standard modules facilitates the modular design of the machine. By using AS-Interface it is not only the PLC I/O modules that are eliminated, but also significant reductions can also be achieved by not having the requirements for the sockets in the control cabinet to connect the machine. A further benefit was also realized in that the location of the main control cabinet no longer has any effect on the design of the machine.*

*Because the necessary safety functions can be integrated into AS-Interface, a*

*Reduced stocking of spare parts thanks to standardized components. It is possible to dispense with the typical terminal boxes and cable and connector assemblies for digital inputs and outputs and for selected analog signals.*



*special safety bus is not required. By only having one cable for the machine control, large wiring looms are no longer a part of the features associated with such high dynamic machines. With the use of standardized components, spares stocking profile is reduced and it is possible to dispense with the terminal boxes, cable and connector assemblies typically used for the digital and analog signals. That means that*

*there are not so many connection diagrams as previously required, a further cost consideration in favor of using AS-Interface.*

*Trumpf has calculated that on their machines, the higher hardware costs are already compensated for by lower installation costs. If logistics, service, and storage are taken into account, the company is making still further savings with AS-Interface.*

## AS-Interface and safety



No risks must be taken when it comes to the safety relevant components of manufacturing automation e.g. emergency stop switches, light barriers, protective door contacts, safety light grids etc. Uninterrupted functional reliability of all the sensors and actuators with reliable feedback signals in the millisecond range have top priority when it comes to protecting personnel and equipment from injury and damage. For many years, these demands meant considerable additional investments in automation systems, because the conventional solution for failsafe actuators and sensors has always been parallel circuitry.

### **Safety at work**

With the components “*Safety at work*”, AS-Interface fulfils the requirements for

a safety bus. Safety related and non safety related digital I/O data can be transmitted along the same AS-Interface cable.

### **How does it all work and can it really be safe?**

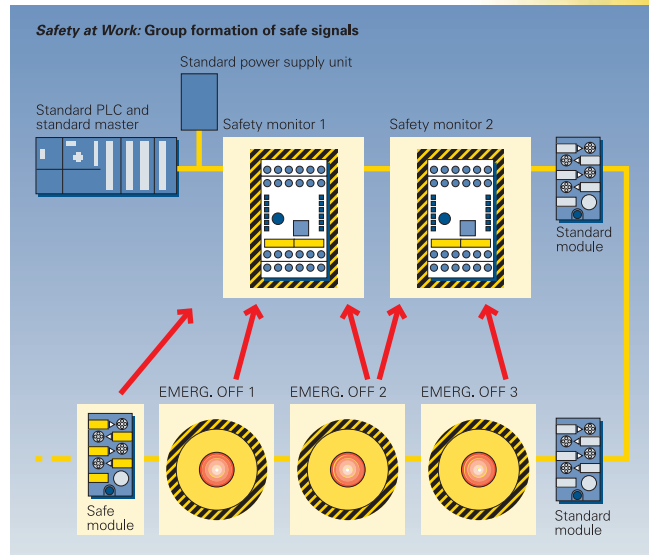
Included in the list of AS-Interface components already familiar to us (master, slave, power supply unit ...) is the safety monitor and safety related slaves that are operated on the same AS-Interface network.

The master identifies the safety related slaves in the same way as any other slave and integrates it in the network like all conventional slaves.

The transmission protocol and the cable of the standard AS-Interface are so robust that they can also be used for safety related telegrams. The required safety is achieved by additional signal transmission between the safe slaves and the safety monitor. The safety monitor waits for a four bit telegram from each safety related slave which continuously changes according to a defined algorithm. If the telegram expected from a safety related slave does not arrive or



Example of group formation of safe signals in the AS-Interface: The 3 EMERG. OFF buttons in the example are implemented in such a way that they can be connected directly to the yellow AS-Interface cable. In that way, they conform to category 4 to EN 954-1. The safe module has 2 safe inputs. Standard sensors, e.g. limit switches, etc. to category 2 (2 inputs) or category 4 (1 dual-channel input) can be connected. The safe module and EMERG. OFF 1 act on safety monitor 1. For example, if EMERG. OFF 1 is pressed, the subsystem assigned to the monitor via the associated enable circuit is switched off. EMERG. OFF 2 acts on both safety monitors, i.e. operating EMERG. OFF 2 switches both plant subsystems off. EMERG. OFF 3 only acts on safety monitor 2.



the slave continuously transmits the telegram 0-0-0-0 (e.g. EMERGENCY STOP pressed) because of a fault, the safety monitor switches off the safety-related outputs via its dual-channel isolation circuits after no more than 35 ms. If several monitors are used in a network; it is possible to form groups of safety-related signals.

The system operates so reliably that it can be used in applications up to category 4 according to EN 954-1 and has been certified by the German safety body TÜV.

### Forming safe component groups

With AS-Interface "safety at work" it is possible to assemble safety signals into groups. The illustration shows a network that contains not only the known standard components but also two safety monitors, each with a dual-channel enable circuit and 4 safe slaves. For example, each monitor can be assigned to a plant subsystem that can be shut down using the enable circuit. Assignment of safe slaves to the safety monitors within an AS-Interface network can be configured during commissioning.

## AS-Interface and Siemens

From Siemens you can obtain all the components you require for installation, operation, and maintenance of an AS-Interface network. The offer is complete and adapted to the user's requirements: From a simple standalone network to a highly specialised solution with AS-Interface working in conjunction with other bus and control systems in many different ways, all components are offered. Even integration into decentralised drive solutions, e.g. local control of contactors or motor starters is possible. The offer for integration of pneumatics into the AS-Interface environment is broad and opens up numerous ways of implementing demanding actuator systems for the user. In addition to field devices with degree of protection IP67, Siemens can also supply AS-Interface modules with degree of protection IP20 for installation in control cabinets and special modules for low cost and space saving control configuration.

Siemens consistently supports the AS-Interface standard and is developing it further to broaden its functionality. Compatibility with AS-Interface devices of other manufacturers is ensured. One example of this is the development of the new AS-Interface ASICs SAP 4.1 from Siemens, which noticeably increases the functionality of the AS-Interface network, e.g. by increasing the number of slaves that can be operated in a network from 31 to 62 and thus enabling even more cost effective operation.



### Approval

All AS-Interface components from Siemens have been approved by international and national standardisation bodies (for example by UL CSA for North America and for marine engineering).

### Service and support

As the trend-setter in this technology, Siemens is pursuing technical progress with the power and possibilities only available to a global corporation. A powerful service and support offer provides the user with competent and fast help with all questions to do with the technology and development of custom automation solutions. With the know-how of Siemens, the automation professional, with the superior technology of AS-Interface, with the quality track record of our products, and with comprehensive service, the user can be certain of solving his automation problem quickly with the best possible result and therefore of being productive within a short time.

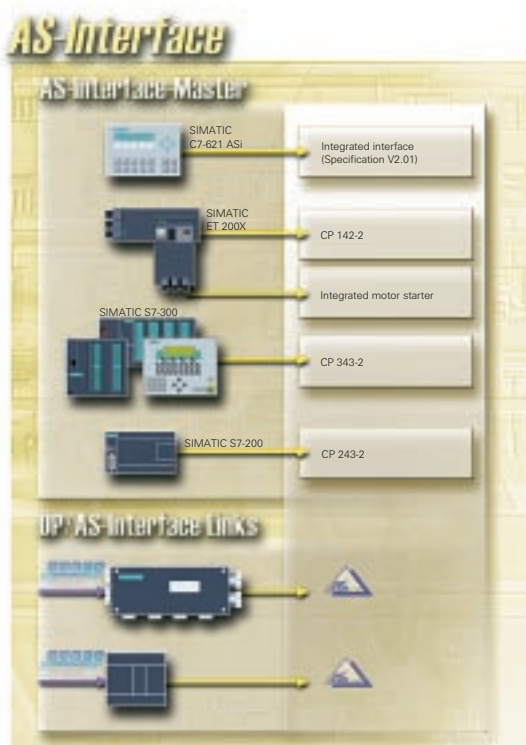
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[www.siemens.de/as-interface](http://www.siemens.de/as-interface)

You can contact us at:

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# Product overview



The range of Siemens AS-Interface components is too extensive to deal with adequately in this brochure. You can read about all products and technical data in the catalog "Components on the field bus" (low voltage field technology (NSK) and IK PI) that your Siemens contact stocks for you. Or you can access this information directly on the Internet (see Page 34). This section therefore only gives you a short list of the most important product groups that you can obtain from Siemens.

## SIMATIC NET AS-Interface master

For SIMATIC controllers there are communication processors (CP's) that control the process or field communication as a master. For direct connection of the AS-Interface to PROFIBUS-DP, the DP/AS-Interface link 20E is available. With that you can use the AS-Interface as a subnetwork for PROFIBUS-DP.

Connection of the SIMATIC S7-400 and other PROFIBUS-DP masters to AS-Interface for which no AS-Interface CP is available can be implemented using the DP/AS-Interface link 20E. For the SIMATIC S7 300, the CP 343-2 and for the S7 200 the CP 234-2 is used. Both communication processors and the DP/AS-Interface link 20E fulfill the extended AS-Interface Specification V2.1 that allows up to 62 slaves to be connected, and the integrated analog value transmission.

All the following AS-Interface masters have these functions: They support all AS-Interface master functions according to the extended AS-Interface Specification V2.1. Up to 62 AS-Interface slaves can be connected and integrated analog value transmission is possible (according to the extended AS-Interface Specification V2.1) All of the listed CP's allow commissioning times to be considerably reduced by offering configuration of the network at the press of a button.

The idle and service times are also reduced because of the simplified error location indicated by the operating status displays on the front of the CP's, and the ready-to-operate indication of the connected slaves, again with LED's on the front of the units.

PRODUCT OVERVIEW

### DP/AS-Interface link 20E

The DP/AS-Interface link 20E connects PROFIBUS-DP with AS-Interface at transmission speeds up to 12Mb. The link 20E is a PROFIBUS-DP slave and an integrated AS-Interface master in one housing that is IP20 rated. It is powered from the AS-Interface cable; so no additional 24v power supply is necessary for the system.



### CP 343-2

The CP 343-2 is the AS-Interface master for the SIMATIC S7-300 programmable controller and the ET 200M distributed I/O range of equipment. The communication processor has displays for the operating states and a ready-for-operation display for the connected slaves depicted by LED's on the front of the unit. It is possible to configure flexible distributed structures using this product in the ET 200M DP format.

### CP 243-2

The CP 243-2 is the master connection of the innovated generation of the SIMATIC S7 200© to the AS-Interface. This results in more flexible and extended applications of the SIMATIC S7-200 range of PLC's by increasing the number of available digital inputs/outputs. The CP can simply be incorporated into the I/O address range of the SIMATIC S7-200 and offers diagnostics and operating states via LED's on the front panel of the unit.





#### **Master as a compact control for SIMATIC S7**

The SIMATIC C7 621 AS-Interface unites in one complete housing the AS-Interface master CP 342-2, a SIMATIC CPU of the S7-300 class, and an OP3 operator panel. That makes it ideal for quick and simple automation tasks that do not require the performance of a human-machine interface. The addressing and diagnostics of up to 31 slaves with up to 124 inputs and outputs (no integrated inputs and outputs) can be accessed and controlled directly from the compact control. No additional addressing unit is required.



#### **CP 142-2**

An AS-Interface master is available for the distributed I/O system for PROFIBUS networks ET 200X, too. The CP 142-2 communication processor is connected to the ET 200X module via a 12-way connector and uses its standard I/O range. No configuring is required for the AS-Interface network. Up to 31 slaves can be addressed by the CP 142-2 (124 inputs and outputs).



## AS-Interface slaves (I/O modules) for use in cabinets

### Slimline modules

Compact distributed configurations in a control cabinet are possible with the Slimline model available with degree of protection IP20. The modules can be clipped onto a DIN rail or screwed to a back plate like any other low-voltage device in a control cabinet.

In the SlimLine series, the SlimLine S22.5 and S45 variations are available, and can be supplied with either screw terminal or cage clamp connection. With the cage clamp connection method, the cables are clamped through a cage-type spring terminal without screws; this provides added advantages for use in areas where vibration or shock may be a problem for designers.



### Load feeder modules

The control circuit of a load feeder module can be fully pre-wired with the AS-Interface load feeder module. This range has been optimised for applications which include the SIRIUS® 3R load feeder modules sizes S00 and S0.

Four different AS-Interface load feeder modules are available. Direct and reversing starters, as well as double direct starters and starter combinations for pole switchover can be wired with them. The feedback signals from the circuit-breakers and contactor(s) can be scanned at the inputs. The outputs are used for direct control of the contactor coils.

### LOGO! Minicontroller

With the AS-Interface module it is possible to operate the LOGO! as an intelligent slave in all AS-Interface applications. With its local inputs and outputs, logic combinations, and timer functions, the LOGO! is the only slave to provide distributed controller functionality on the AS-Interface network. Moreover, it is possible to set parameters (e.g. timer and setpoints) using the integrated keyboard and display, and to change them without additional devices.



The LOGO! is therefore designed for applications in where higher-level automation systems are integrated with simple decentralized automation tasks, e.g. for access door controls. By having decentralized control it again offers the designers the benefit of localized control should the higher-level control system fail.

## AS-Interface slaves (I/O modules) for use in the field

### Compact modules

The AS-Interface compact modules are part of a new generation of AS-Interface modules available with a high degree of protection. They combine digital, analogue, pneumatic, and 24 V DC motor starter modules in a single family. Two module sizes, the K45 (45 mm wide)



and the K60 (60 mm wide) together meet all installation requirements.

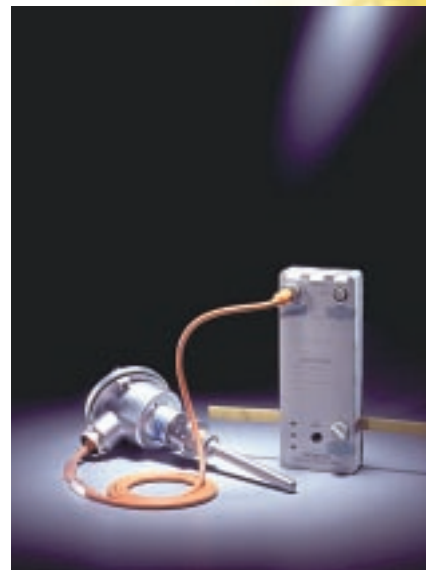
An installed module can be addressed via an integrated addressing socket. Degree of protection IP67 is met by locking the socket with an optional blanking cap. Instant diagnosis is made possible by comprehensive LED displays.

The new A/B slaves according to Specification 2.1 permit still more precise error diagnostics. I/O errors are displayed on the module by different colored LED's. The same diagnostic information is also available on the master.

### Analog modules

At Siemens, analog modules can also be obtained as AS-Interface slaves. All modules are pre-parameterized for communication with programmable controllers of the SIMATIC S7 family. The analog modules each have two channels and are subdivided into five groups: Input module for sensors with current signals, input module for sensors with voltage signals, input module for resistance-type transmitters, output module for actuators with current signals, and output module for actuators with voltage signals.

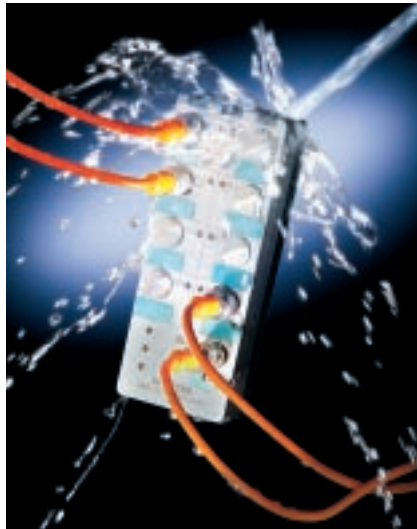
In the modules of Version 2.1, the analog value transmission is completely integrated into the master. In this way, it is now possible to forward a complete analog value digitized in 16-bit (15 bits data plus one sign bit) resolution without additional application programming on the PLC.



### **K60R: The IP68 module for the AS-Interface**

The K60R module, with round cable connection and degree of protection IP68, is now available – and it supplements the K45/K60 series of compact modules with degree of protection IP65/67. The new design can be operated in environments which have high permanent levels of moisture. This results in many practical applications.

- Use in especially moist ambient conditions, for example, in beverage filling systems, on machine tools and in the food and beverage industry.
- The K60R module, with degree of protection IP68, can now be cleaned under high pressures and it is even possible to use liquid cleaning agents capable of film creep.
- The module is connected to the AS-Interface bus and the auxiliary voltage using a round cable which is connected to the module using an M12 connector.



### **Interface microstarter – switching, protecting and communicating in the motor terminal box**

We have now reached another milestone in distributed drive technology in the form of the new AS-Interface microstarter. You can now completely replace the motor terminal box by an AS-Interface microstarter up to 4 kW.

The motor can be mounted in any position. Thanks to its compact design, the AS-Interface Microstarter can be used wherever space is especially tight. Electronic overload protection is especially cool: The motor is continually monitored using thermistor evaluation and when a fault develops, it is automatically tripped. However, the AS-Interface motor starter can do a lot more. Signals, which are available close to the motor (e.g. Bero proximity switches) can be read-in using the two digital inputs integrated in the starter and can be transferred to the AS-Interface master. This means that additional modules can be eliminated. Not only this, the AS-Interface motor starter can be integrated into Category 1 safety concepts (in compliance with EN 954-1). Integrated LEDs make local diagnostics fast and precise. A fault signal is also immediately sent to the AS-Interface master – for a truly integrated drive solution.



#### **24 V DC motor starter**

With the K60 AS-Interface 24 V DC motor starter for the lowest power range up to 70 watts, it is now possible to connect 24 V DC motors and the associated sensors to AS-Interface directly at the machine. Three different versions are available with the following capabilities. Direct starter (without brake and optional quick stop function), double direct starter (with brake and quick stop function), reversing starter (with brake and optional quick stop function).

#### **Cabinet-less decentralization with ECOFAST**

ECOFAS (energy and communication field installation system) is an open system solution for cabinet-less decentralization of machines and plants. All automation and installation components are grouped together to form a complete integrated solution with standardized connections for data and power. For AS-Interface, the following components can be integrated into ECOFAST:

- All I/O modules
- ECOFAST motor starter as a reversing and soft starter for installation near the motor and on the motor
- Motor-integrated micro starter
- Power & Control module (In-feed module) with an integrated PLC and AS-Interface master

### Proximity switches with an integrated AS-Interface

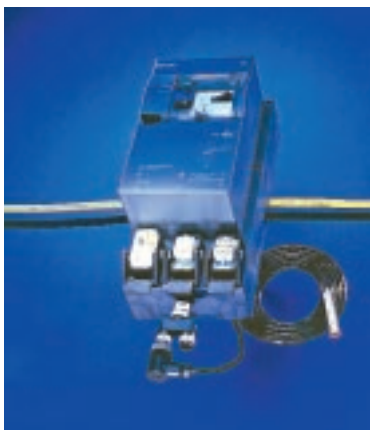
BERO proximity switches can be connected to the AS-Interface directly or via modules. Special inductive, optical and ultrasonic BERO proximity switches suitable for direct connection to the actuator sensor interface are also available. They feature an integrated AS-Interface chip and can supply information (e.g. filling level, coil failure) in addition to that supplied via the switching output. These intelligent BEROs can be parameterised via the AS-Interface cable.



### Compact starter

Our AS-Interface compact starter is a fully internally pre-wired load feeder with degree of protection IP65, designed to switch and protect any three-phase current loads up to 5.5 kW at 400/500 V AC – usually three-phase current standard motors in direct or reversing operation. It includes either an Electro-mechanical switchgear assembly or an electronic overload protection and circuit-breaker unit (max. 2.2 kW). The AS-Interface compact starter can also be addressed when fully wired.

In addition, the compact starter is equipped with two free inputs. This allows you to connect an optical proximity switch, for example, which provides a signal, and local control facility.



### Pushbuttons and LEDs

SIGNUM 3SB3 control devices with AS-Interface have full communications capability. They can be connected to the AS-Interface networking system via the integrated AS-Interface module 4E/4A with minimum wiring. The illuminated command pushbuttons are powered via the AS-Interface cable. Individual connection of control devices is possible with a special AS-Interface slave with separate auxiliary supply, making it possible to connect up to 28 NO contacts and 7 signal outputs to each device.

The SIGNUM 3SB4 is a human machine interface with a complete operator communication system with AS-Interface connection.



## AS-Interface components for safety at work

The concept of “*safety at work*” permits integration of safety-related components such as emergency stop buttons, guard door switches, or safety light grids, to be connected directly into a standard or V2.1 AS-Interface network. These components are fully compatible with the standard AS-Interface components i.e. master, slaves, power supply unit, repeater, etc. according to EN 50295. This new range of safety components has been designed and certified to comply with the relevant European and international safety standards. Siemens can offer and supply all relevant components to construct a safe AS-Interface network solution.

### Safety monitor

The safety monitor is designed to react on the information transmitted via AS-Interface, i.e. master call and response from the safety slave, and stops the plant in a safe state should the safety circuit be interrupted or the safety sensor malfunctions.

For standard AS-Interface bus stations, the master still performs the data transmission function between a PLC and the stations on the bus (sensors and actuators).



### Safe modules type K45

The safe compact module K45F is equipped with two “safe” inputs. For operation up to safety category 3 it is possible to assign both inputs separately. If category 4 is required, a dual-channel input is available on the module via an M12 connection.





### Emergency stop button

Through the standard AS-Interface with safety-related communication, it is now even possible to connect EMERG. STOP devices directly. This also applies to EMERG. STOP command devices in the SIGNUM 32B3 range for front panel mounting, and for installation in a separate housing.

### Light grid/light curtains

The light curtains and light grids available up to category 4 to EN 954-1 can provide active optical protection for people at machines stations. The option is available to connect the units via a safe input device or connect directly to the AS Interface network.



### Protection monitoring and SIGUARD position switch

Suitable for direct connection to the AS-Interface network. There is a special interface module designed for this unit that can be installed on the thread of a position switch. This removes the need to conventionally wire the safety functions.



### SIGUARD laser scanner

The SIGUARD laser scanner is an optical surface sensor for securing hazardous zones up to safety category 3 according to EN 954-1. It is also available with a safe AS-Interface connection.

## Other system components

### Addressing and diagnostic unit

With the new device it is possible to address both the standard slaves with addresses 0 to 31 and the new slaves according to Specification 2.1 with addresses 0 to 31 A, B. In addition, the I/O and ID codes of the slaves can be displayed. Additional functions available are the ability to program the ID code 1, function check of the connected slaves, detection of the complete system, diagnostics, storage of configurations, and a PC gateway function.

### Power supply units

Depending on the power requirement of the AS-Interface network, a range of power supply units rated from 2.4 to 7 A is available. They produce a controlled DC voltage of 30 V DC with a high degree of stability and a low residual ripple to comply with the AS Interface specification.





### Repeaters and extenders

Repeaters extend the AS-Interface segment by 100 m to increase the networks flexibility in the design and implementation stages. The extender increases the distance between the master and the first AS-Interface segment containing AS-Interface slaves to max. 100 m. Note: it is not possible to install slaves between the extender and the master.

### SIRIUS contactors

SIRIUS contactors sizes S6, S10, and S12 are the first contactors with an integrated interface with AS-Interface. As intelligent slaves they can transmit contactor control and monitoring signals via AS-Interface. These include signals about the switching state (on/off), operating mode (automatic via bus or local control) and a signal indicating the remaining operational life (defined number of switching cycles reached). Through a free input it is also possible to process a group of alarm signals, e.g. that the overload relay has tripped and so display this as diagnostic information within your control system.



### SIRIUS soft starters

The SIRIUS 3RW30 soft starters type S00 allows you to combine soft starters with AS-Interface via the 3RK load feeder adaptation modules. A 5-way power connector connects the AS-Interface module with the load; this reduces the mounting and commissioning effort of the system. This compact design minimizes the space requirement for the load feeder in the cabinet, so reducing the overall dimensions of the cabinet. With SIKOSTART 3RW34 it is possible to equip an AS-Interface control board as an option. Control of the soft starter such as starting, stopping, and feedback of the control contacts can then be controlled through the AS-Interface network.



## **Contact**

If there are any further questions regarding AS-Interface made by Siemens, please contact our experts of the "Technical Assistance":

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